

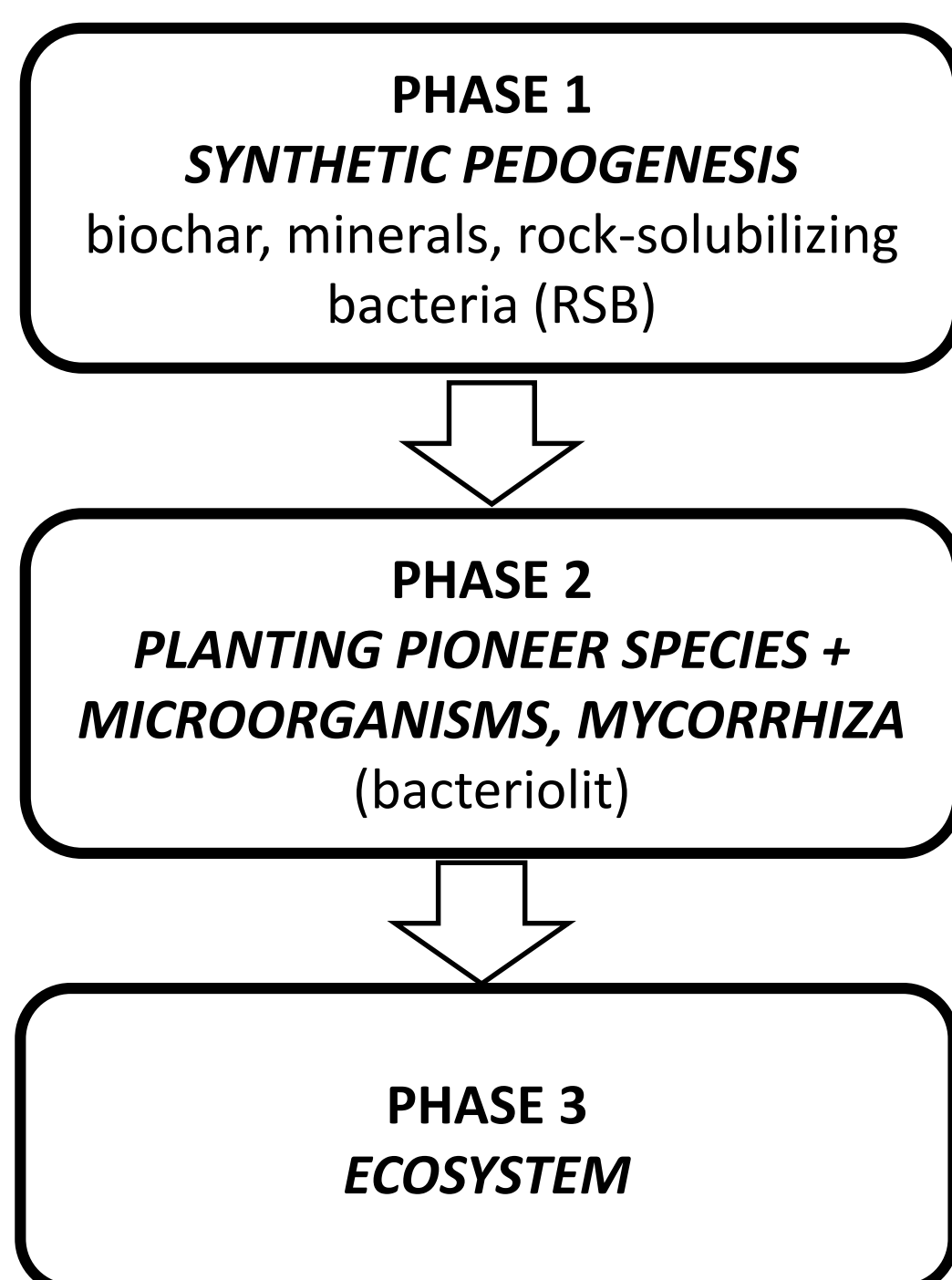
## Biorestorer: Engineered Soils and Synthetic Succession for Restoration of Degraded Land

Jan Chvojka

Independent Researcher; 191 Slovenské Pravno; 03822; Slovakia; [chvojka191@gmail.com](mailto:chvojka191@gmail.com)

### INTRODUCTION & AIM

In extremely degraded environments, **natural soil is often absent**, making conventional restoration (compost, humus, native topsoil) **infeasible** [3].



#### Aim:

To test the creation of **proto-soil (protopedon)** using only **mineral and inert materials**, with **minimal** (practically negligible) **organic matter — no humus, no compost, and no intentionally added organic amendments** — and to evaluate its ability to support growth of **white mustard (*Sinapis alba*)** as a **non-pioneer test species**, within a system designed to mimic **primary succession** in a faster, controlled form.

Concept detailed in: Chvojka (2025), [doi.org/10.31223/X5P44H](https://doi.org/10.31223/X5P44H)

Figure: Basic diagram of synthetic succession (Biorestorer concept)

### METHOD

A small-scale test was conducted under controlled indoor conditions using **32 L** of **substrate**, kept moist throughout. The **first phase — synthetic pedogenesis** — lasted **5 weeks**, after which **five white mustard (*Sinapis alba*)** were sown as a **non-pioneer test species** and **Bacteriolit (Marcel Mézy)** was applied as a **microbial inoculant** at a rate of **1 g per 3.2 L pot**.

#### Composition (v/v):

10% biochar (600 °C, biological waste, high ash, ~40% C)  
20% dolomite rubble (natural microbial inoculant)  
70% basalt gravel (Fugensplitt, 1-3 mm) [13]



Any organic matter present in the **dolomite rubble** is **minimal**. Its contribution to the total substrate volume is **negligible**, resulting in a substrate that is **functionally** and **compositionally mineral**.

#### Pre-treatment:

Biochar + basalt (1:1) soaked in **1% vinegar** ( $\approx 0.08\%$  acetic acid) for 24 h.  
No rinsing → all solubles retained.

Figure: Dolomitic rubble (natural microbial inoculant)

### RESULTS & DISCUSSION

- **pH:** 7.5 (measured after 2 weeks, remained stable)
- **Iron detected:** >0.1 mg/L (drop-based spot test)
- **Visible aggregation observed**

#### Interpretation:

Dolomite acted mainly as a microbial inoculant and buffer, limiting acidification. Vinegar-treated biochar triggered initial microbial activation with only a transient pH effect. Aggregation indicates onset of synthetic pedogenesis [6,8,19]. Successful germination and growth of **white mustard (*Sinapis alba*)** on this purely mineral substrate confirm that the proto-soil provided adequate conditions even for a non-pioneer species.



Figure: White mustard (*Sinapis alba*) — number of days after sowing

### CONCLUSION

The Biorestorer system enables proto-soil formation in environments without natural soil. This proof-of-concept showed stable pH, aggregate formation, iron availability, and successful growth of **white mustard (*Sinapis alba*)** on a purely mineral substrate — confirming its potential to accelerate ecosystem initiation from years to weeks.

### FUTURE WORK / REFERENCES

**Succession plan:** White mustard (*Sinapis alba*) grown as **green manure** to provide initial **organic matter**, followed by **bush bean (*Phaseolus vulgaris* cv. Sonesta)** to fix atmospheric nitrogen and further **enrich the proto-soil**.

#### References:

- [3] Aronson, J. et al. Restor. Ecol. 1993, 1, 8–17.  
[6] Uroz, S. et al. Trends Microbiol. 2009, 17, 378–387.  
[8] Schmidt, H.-P. et al. GCB Bioenergy 2021, 13, 1708–1730.  
[13] Wilson, M.J. In Treatise on Geochemistry, 2004.  
[19] Beesley, L. et al. Environ. Pollut. 2011, 159, 3269–3282.  
Preprint: <https://doi.org/10.31223/X5P44H>